

interference values must meet the tolerance specified in paragraph (c) of this section.

[74 FR 56515, Oct. 30, 2009]

§ 1065.376 Chiller NO₂ penetration.

(a) *Scope and frequency.* If you use a chiller to dry a sample upstream of a NO_x measurement instrument, but you don't use an NO₂-to-NO converter upstream of the chiller, you must perform this verification for chiller NO₂ penetration. Perform this verification after initial installation and after major maintenance.

(b) *Measurement principles.* A chiller removes water, which can otherwise interfere with a NO_x measurement. However, liquid water remaining in an improperly designed chiller can remove NO₂ from the sample. If a chiller is used without an NO₂-to-NO converter upstream, it could remove NO₂ from the sample prior NO_x measurement.

(c) *System requirements.* A chiller must allow for measuring at least 95% of the total NO₂ at the maximum expected concentration of NO₂.

(d) *Procedure.* Use the following procedure to verify chiller performance:

(1) *Instrument setup.* Follow the analyzer and chiller manufacturers' start-up and operating instructions. Adjust the analyzer and chiller as needed to optimize performance.

(2) *Equipment setup and data collection.* (i) Zero and span the total NO_x gas analyzer(s) as you would before emission testing.

(ii) Select an NO₂ calibration gas, balance gas of dry air, that has an NO₂ concentration within $\pm 5\%$ of the maximum NO₂ concentration expected during testing.

(iii) Overflow this calibration gas at the gas sampling system's probe or overflow fitting. Allow for stabilization of the total NO_x response, accounting only for transport delays and instrument response.

(iv) Calculate the mean of 30 seconds of recorded total NO_x data and record this value as x_{NOxref} .

(v) Stop flowing the NO₂ calibration gas.

(vi) Next saturate the sampling system by overflowing a dewpoint generator's output, set at a dewpoint of 50 °C, to the gas sampling system's probe or

overflow fitting. Sample the dewpoint generator's output through the sampling system and chiller for at least 10 minutes until the chiller is expected to be removing a constant rate of water.

(vii) Immediately switch back to overflowing the NO₂ calibration gas used to establish x_{NOxref} . Allow for stabilization of the total NO_x response, accounting only for transport delays and instrument response. Calculate the mean of 30 seconds of recorded total NO_x data and record this value as x_{NOxmeas} .

(viii) Correct x_{NOxmeas} to x_{NOxdry} based upon the residual water vapor that passed through the chiller at the chiller's outlet temperature and pressure.

(3) *Performance evaluation.* If x_{NOxdry} is less than 95% of x_{NOxref} , repair or replace the chiller.

(e) *Exceptions.* The following exceptions apply:

(1) You may omit this verification if you can show by engineering analysis that for your NO_x sampling system and your emission calculations procedures, the chiller always affects your brake-specific NO_x emission results by less than 0.5% of the applicable NO_x standard.

(2) You may use a chiller that you determine does not meet this verification, as long as you try to correct the problem and the measurement deficiency does not adversely affect your ability to show that engines comply with all applicable emission standards.

[73 FR 37312, June 30, 2008]

§ 1065.378 NO₂-to-NO converter conversion verification.

(a) *Scope and frequency.* If you use an analyzer that measures only NO to determine NO_x, you must use an NO₂-to-NO converter upstream of the analyzer. Perform this verification after installing the converter, after major maintenance and within 35 days before an emission test. This verification must be repeated at this frequency to verify that the catalytic activity of the NO₂-to-NO converter has not deteriorated.

(b) *Measurement principles.* An NO₂-to-NO converter allows an analyzer that measures only NO to determine total

NO_x by converting the NO₂ in exhaust to NO.

(c) *System requirements.* An NO₂-to-NO converter must allow for measuring at least 95% of the total NO₂ at the maximum expected concentration of NO₂.

(d) *Procedure.* Use the following procedure to verify the performance of a NO₂-to-NO converter:

(1) *Instrument setup.* Follow the analyzer and NO₂-to-NO converter manufacturers' start-up and operating instructions. Adjust the analyzer and converter as needed to optimize performance.

(2) *Equipment setup.* Connect an ozonator's inlet to a zero-air or oxygen source and connect its outlet to one port of a three-way tee fitting. Connect an NO span gas to another port, and connect the NO₂-to-NO converter inlet to the last port.

(3) *Adjustments and data collection.* Perform this check as follows:

(i) Set ozonator air off, turn ozonator power off, and set the analyzer to NO mode. Allow for stabilization, accounting only for transport delays and instrument response.

(ii) Use an NO concentration that is representative of the peak total NO_x concentration expected during testing. The NO₂ content of the gas mixture shall be less than 5% of the NO concentration. Record the concentration of NO by calculating the mean of 30 seconds of sampled data from the analyzer and record this value as x_{NOref} .

(iii) Turn on the ozonator O₂ supply and adjust the O₂ flow rate so the NO indicated by the analyzer is about 10 percent less than x_{NOref} . Record the concentration of NO by calculating the mean of 30 seconds of sampled data

from the analyzer and record this value as $x_{\text{NO} + \text{O2mix}}$.

(iv) Switch the ozonator on and adjust the ozone generation rate so the NO measured by the analyzer is 20 percent of x_{NOref} or a value which would simulate the maximum concentration of NO₂ expected during testing, while maintaining at least 10 percent unreacted NO. This ensures that the ozonator is generating NO₂ at the maximum concentration expected during testing. Record the concentration of NO by calculating the mean of 30 seconds of sampled data from the analyzer and record this value as x_{NOmeas} .

(v) Switch the NO_x analyzer to NO_x mode and measure total NO_x. Record the concentration of NO_x by calculating the mean of 30 seconds of sampled data from the analyzer and record this value as x_{NOxmeas} .

(vi) Switch off the ozonator but maintain gas flow through the system. The NO_x analyzer will indicate the NO_x in the NO + O₂ mixture. Record the concentration of NO_x by calculating the mean of 30 seconds of sampled data from the analyzer and record this value as $x_{\text{NOx} + \text{O2mix}}$.

(vii) Turn off the ozonator O₂ supply. The NO_x analyzer will indicate the NO_x in the original NO-in-N₂ mixture. Record the concentration of NO_x by calculating the mean of 30 seconds of sampled data from the analyzer and record this value as x_{NOxref} . This value should be no more than 5 percent above the x_{NOref} value.

(4) *Performance evaluation.* Calculate the efficiency of the NO_x converter by substituting the concentrations obtained into the following equation:

$$\text{efficiency} = \left(1 + \frac{x_{\text{NOxmeas}} - x_{\text{NOx} + \text{O2mix}}}{x_{\text{NO} + \text{O2mix}} - x_{\text{NOmeas}}} \right) \cdot 100\%$$

(5) If the result is less than 95%, repair or replace the NO₂-to-NO converter.

(e) *Exceptions.* The following exceptions apply:

(1) You may omit this verification if you can show by engineering analysis

that for your NO_x sampling system and your emission calculations procedures, the converter always affects your brake-specific NO_x emission results by

less than 0.5% of the applicable NO_x standard.

[70 FR 40516, July 13, 2005, as amended at 73 FR 37313, June 30, 2008; 73 FR 59330, Oct. 8, 2008; 76 FR 57447, Sept. 15, 2011]

PM MEASUREMENTS

§ 1065.390 PM balance verifications and weighing process verification.

(a) *Scope and frequency.* This section describes three verifications.

(1) Independent verification of PM balance performance within 370 days before weighing any filter.

(2) Zero and span the balance within 12 h before weighing any filter.

(3) Verify that the mass determination of reference filters before and after a filter weighing session are less than a specified tolerance.

(b) *Independent verification.* Have the balance manufacturer (or a representative approved by the balance manufacturer) verify the balance performance within 370 days of testing.

(c) *Zeroing and spanning.* You must verify balance performance by zeroing and spanning it with at least one calibration weight, and any weights you use must that meet the specifications in § 1065.790 to perform this verification.

(1) Use a manual procedure in which you zero the balance and span the balance with at least one calibration weight. If you normally use mean values by repeating the weighing process to improve the accuracy and precision of PM measurements, use the same process to verify balance performance.

(2) You may use an automated procedure to verify balance performance. For example many balances have internal calibration weights that are used automatically to verify balance performance.

(d) *Reference sample weighing.* Verify all mass readings during a weighing session by weighing reference PM sample media (e.g., filters) before and after a weighing session. A weighing session may be as short as desired, but no longer than 80 hours, and may include both pre-test and post-test mass readings. We recommend that weighing sessions be eight hours or less. Successive mass determinations of each reference PM sample media (e.g., filter) must re-

turn the same value within ± 10 μ g or $\pm 10\%$ of the net PM mass expected at the standard (if known), whichever is higher. If successive reference PM sample media (e.g., filter) weighing events fail this criterion, invalidate all individual test media (e.g., filter) mass readings occurring between the successive reference media (e.g., filter) mass determinations. You may reweigh these media (e.g., filter) in another weighing session. If you invalidate a pre-test media (e.g., filter) mass determination, that test interval is void. Perform this verification as follows:

(1) Keep at least two samples of unused PM sample media (e.g., filters) in the PM-stabilization environment. Use these as references. If you collect PM with filters, select unused filters of the same material and size for use as references. You may periodically replace references, using good engineering judgment.

(2) Stabilize references in the PM stabilization environment. Consider references stabilized if they have been in the PM-stabilization environment for a minimum of 30 min, and the PM-stabilization environment has been within the specifications of § 1065.190(d) for at least the preceding 60 min.

(3) Exercise the balance several times with a reference sample. We recommend weighing ten samples without recording the values.

(4) Zero and span the balance. Using good engineering judgment, place a test mass such as a calibration weight on the balance, then remove it. After spanning, confirm that the balance returns to a zero reading within the normal stabilization time.

(5) Weigh each of the reference media (e.g., filters) and record their masses. We recommend using substitution weighing as described in § 1065.590(j). If you normally use mean values by repeating the weighing process to improve the accuracy and precision of the reference media (e.g., filter) mass, you must use mean values of sample media (e.g., filter) masses.

(6) Record the balance environment dewpoint, ambient temperature, and atmospheric pressure.

(7) Use the recorded ambient conditions to correct results for buoyancy as